DOMESTIC WATER TREATMENT
IN NEW BRUNSWICK

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WATER RESOURCE PLANNING BRANCH

NEW BRUNSWICK DEPARTMENT OF
MUNICIPAL AFFAIRS AND ENVIRONMENT

DOMESTIC WATER TREATMENT

IN

NEW BRUNSWICK

(Short Booklet)

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1.0 INTRODUCTION

The decision on whether or not to treat your water depends on many things. The water may be aesthetically displeasing or there may be health concerns with drinking the water. In general, the necessity of treatment can be determined by comparing an analysis of your water with the latest Guidelines For Canadian Drinking Water Quality 1978 (Health and Welfare Canada, 1979). An abbreviated version of the guidelines is presented in Table 1. Should the various parameters measured in your water analysis exceed the guideline values, it may be worthwhile to consider some sort of water treatment.

Prior to looking at water treatment, it is important to consider the nature of the problem and its possible causes. Water treatment is not always the best solution to the problem. For instance, a high nitrate-bacteria problem is most easily dealt with by removing potential sources of pollution, such as manure piles, from the area of the well.

A list of common water quality problems and possible water treatment solutions is presented in Table 2. A few details on both the nature of the problems and the treatment units are provided in the text.

The decision to use a particular treatment method depends on the nature of the problem, existing water quality, quantity of water used, quality of water desired, and the cost.

TABLE 1

Abbreviated Guidelines for Canadian
Drinking Water Quality 1978

Parameter	Maximum Acceptable Limit	Objective Limit
Colour	15 TCU	<15 TCU
Odour	-	inoffensive
Taste	-	inoffensive
Turbidity	5 NTU	<1 NTU
pH	6.5 - 8.5	-
Arsenic	0.05*	≤0.005
Chloride	250	<250
Copper	1.0	<1.0
Fluoride	1.5*	1.0
Hardness	500	80 - 100
Hydrogen Sulfide	0.05*	<0.05
Iron	0.3	<0.05
Lead	0.05*	≤0.001
Manganese	0.05	≤0.01
Nitrate (as N)	10.0*	≤0.001
Sulfate	500*	<150
Total Dissolved Solids	500	-
Uranium	0.02	≤0.001
Zinc	5.0	≤5.0
Bacteria (Maximum Acceptable Limits)	*(1) 10 or less total coliform per 100 ml of water; (2) no coliform in more than 10% of samples in a 30 day period; (3) no coliform present in more than 2 consecutive samples from the site; and (4) no fecal coliforms	

* - Denotes a limit based on health considerations
< - Indicates "less than"
≤ - Indicates "less than or equal to"
All parameters measured in milligrams/litre, except:
Colour - TCU (true colour units)
Turbidity - NTU (Nepelometric turbidity units)
pH - pH units

TABLE 2

Common Water Quality Problems

Symptoms	Possible Cause	Treatment and Reference Section
-Sticky curd forms when soap is added to water -Excess soap consumption -Glassware appears streaked and murky -Hard, scaly deposits inside pipes and kettle	Hardness	Water softening (3.4) Phosphate additives (3.5)
-Red water -Red stains on clothes and porcelain -Water has metallic taste	Iron	Water softening (3.4) Chemical oxidation and filtration (3.6) Greensand filters (3.7)
-Red water -Red slime develops in toilet tanks	Iron Bacteria	Shock chlorination (3.20) Chemical chlorination and filtration (3.6)
-Brownish-black water -Black stains on porcelain -Coffee and tea have a bitter taste	Manganese/ Iron	Same correctional measures as used for iron
-Gastro-intestinal disease	Bacteria or virus	Disinfection with: Chlorine (3.1) Iodination (3.2) Ultraviolet (3.3)
-Pipes and fixtures are "eaten away" -Green stains under dripping faucets	Acid Water	Neutralizing tank (3.8) Alkali addition (3.9)
-Salty taste -Corrosive taste	Chloride	Reverse osmosis (3.11) Deiozination (3.13) Distillation (3.19)
-Bitter Taste -Laxative effect	Sulphate	Dealkalization (3.12) Distillation (3.19)

TABLE 2 (contd.)

Common Water Quality Problems

Symptoms	Possible Cause	Corrective Measures and Reference Section
-Blue hue in infants	Nitrate	Deionization (3.13) Distillation (3.19) Reverse osmosis (3.11) Freezing/thawing (3.14)
-Rotten egg odour -Corrodes iron, steel, and copper parts of pumps, pipes, and fixtures	Hydrogen Sulphide Gas	Activated carbon (3.15) Chlorine oxidation (3.6) Greensand filter (3.7)
-Cloudy or turbid water	Silt, Sediment	Sand filters (3.18) Coagulation (3.16)
-Neural problems, skin lesions, etc.	Arsenic	Distillation (3.19) Reverse osmosis (3.11)
-Uranium and/or radioactivity	Uranium, Radon	Distillation (3.19) Reverse osomsis (3.11)
-Hypertension	Sodium	Reverse osmosis (3.11) Distillation (3.19)
-Clear tea-like colour	Humic Acids	Activated carbon (3.15)
-Gasoline-type odour	Gasoline, Fuel oil	Activated carbon (3.15) Reverse osmosis (3.11) Aeration (2.9)

Note: Some treatment may require more than one step.

Before treatment is decided upon, the feasibility of all possible options should carefully assessed. Alternatives to treatment might include the following;

1) A new Well

2) A collective system with a neighbour(s)

3) Hook-up to Municipal System

4) Rain water collection for direct use or mixing.

Carefull analysis both of the water quality problem and the feasible solutions will be required to ensure that the most suitable option is chosen.

Water treatment needs to be approached in a systematic way in order to ensure its cost-effectiveness. The first step is to properly define the problem or treatment need. Usually this means that a number of water samples need to be taken. These should be representative as is possible; that is they should be typical of the problem. If large variation is seen in the chemical quality then more samples should be taken to ensure that this variation is well understood.

As the sample(s) that you take will influence the kinds of treatment finally decided upon and on the final cost, it is very important that this work be done as objectively as possible by a reliable laboratory.

Some problems can be solved simply by performing adequate maintenance either on the well, the pumping system or the septic

tank. For example shock chlorination every six months may be the most cost effective approach to controlling a low level iron problem. Adequate access will be needed to make this easy to perform.

Turbidity problems may have a variety of causes which might be caused by the water system. Common easy to solve problems include a blocked vent at the wellhead, or pump suctions that are set too deeply in the well. You must be certain that the water system is not causing or contributing to the problem before you choose treatment. Other problems can be solved by installing more casing or by sealing the existing casing or draining the wellhead area.

There are times and circumstances when treatment even when suitable, may not be appropriate. There are no simple rules that can be followed, however typical circumstances when treatment would not be the best solution are;

1) When it can't be economically done for the quantity of water required (eg. Salt).
2) When non contaminated alternative sources are cost competitive (see options above).
3) When problem can easily be solved by other means, perhaps by removing the source of the problem.
4) When the treatment method is not technically feasible for the domestic water supply situation in general or for a specific water quality type (eg. sulphate, pesticides).

The initial cost of treatment and the cost of maintenance is directly related to the amount of water which is treated. It may be essential with some forms of treatment to reduce the amount treated to that which is required. Drinking water standards are usually the most stringent. Most households only need 20 to 40 litres of water solely for drinking purposes. Some mixing after treatment will improve the taste of the finished product and give the required treatment to a larger quantity of water and so is worthy of consideration. This is particularly true of reverse osmosis or distillation which remove almost all the mineral content.

When asking for quotations for water treatment equipment, be sure that estimates of operating and maintenance costs are included. This would normally include the cost of replacement resins, chemicals, replacement cartridges and electrical power. Under adverse circumstances these costs may become prohibitive. Suppliers should be able to tell you typical costs for their equipment for the most common applications.

1.1 Water Sample Collection and Analysis

A water sample should be collected and analyzed prior to deciding whether treatment is required and what type of treatment is necessary. A sample for mineral analysis can be collected in a clean bottle, preferably one provided by the lab. The tap should run for several minutes prior to collecting the sample so

as to get water directly from the well. The bottle should be filled. Mineral water analyses can be conducted at the following laboratories:

Atlantic Analytical, 27 Clyde Street, Saint John, New Brunswick E2L 5AB. Telephone: (506) 634-1771. Minimum charge: $75/sample.

Environmental Chemistry, Division of Clinical Chemistry, 5788 University Avenue, Halifax, Nova Scotia
Telephone: (902) 428-3466

K-F Laboratories, P.O. Box 1390, Fredericton, New Brunswick E3B 5E3 Telephone: (506) 455-0612

RPC, P.O. Box 6000, Fredericton, New Brunswick E3B 5H1
Telephone: (506) 452-8994. Minimum charge: $125/sample.

Where well pollution problems are suspected, New Brunswick Department of Municipal Affairs and Environment Inspectors should be contacted prior to having the water analyzed (see Appendix 1).

A sample for bacterial analysis requires a special, sterilized bottle and must be delivered to District Medical Health Offices as soon as possible after sample collection. "Bacteria" bottles are available from Public Health Inspectors (see Appendix 1). There is no charge for bacterial analyses.

2.0 WATER QUALITY PROBLEMS

2.1 Bacteria

Bacterial well contamiantion results from such things as inappropriate siting of septic tanks, poor well construction and improper drainage. Prior to implementation of any disinfection procedure all reasonable measures to eliminate the problem at the source should be carried out (i.e. well reconstruction, removal of waste piles, diversion of drainage, etc.).

Water supplies derived from surface water and rainwater almost always require disinfection. Disinfection involves killing microorganisms by various means, such as chlorination (Section 3.1), iodination (Section 3.2), and ultraviolet irradiation (Section 3.3). Temporary disinfection can be conducted by "shot" or "shock" chlorination where a quantity of bleach is added to the well (Section 3.20).

2.2 Hard Water

Hardness in water is commonly defined as the inability of the water to form soap lather. Actual hardness is determined by the calcium and magnesium content of the water. These elements dissolve as the water flows through rocks such as limestone, dolomite, and gypsum. Table 3 indicates the suitability of water with respect to various hardness levels.

Water hardness can be removed by means of a water softener (Section 3.4) or by adding phosphate additives using a chemical feed pump (Section 3.5).

TABLE 3

Hardness Values and Acceptability of Water

Hardness		
Grains per Imperial Gallon	Milligrams Per Litre	Rating
5 - 6	80 - 100	Acceptable
12	200	Undesirable
30	500	Unsuitable

2.3 Iron and Manganese

In New Brunswick, iron concentrations in groundwater may range from 0.01 to 10.0 milligrams/litre. Iron and manganese greater than the respective recommended limits of 0.3 and 0.05 milligrams/litre may stain sinks, discolour laundry, and impart a bitter taste to beverages such as coffee or tea. Iron and manganese in drinking water are not considered to be health hazards. These minerals may be removed by means of a water softener (Section 3.4), a greensand filter (Section 3.7), or a chlorination/filtration unit (Section 3.6).

2.4 Acidity

Acidity is commonly expressed in pH units (although technically speaking this is not entirely correct). The pH scale ranges from 0, which is extremely acid, to 14, which is extremely basic (i.e. caustic or alkaline). A pH of 7 is neutral. The average pH of groundwater in New Brunswick is about 7.0.

Acidic water is frequently, but not necessarily, corrosive. For instance, salt water is corrosive yet may not be acidic. Acidity is considered to be the most important factor causing corrosion solely because it is easily adjusted. Treatment methods should aim to neutralize the pH of the water. Low pH water may increase corrosion of plumbing resulting in elevated iron, lead, copper, and/or zinc concentrations. It should be noted that the standard methods for pH adjustment, tank-type neutralizing filters (Section 3.8) and alkali addition (Section 3.9), may cause iron and manganese to "come out" of the water and clog the filter, well, or plumbing system.

2.5 Chloride, Sulphate, and Nitrate

The recommended limits for chloride, sulphate, and nitrate in drinking water in Canada are 250, 500, and 10 milligrams/litre (45 milligrams/litre nitrogen), respectively. High chloride concentrations often mean high sodium concentrations, a potential concern for persons with high blood pressure or heart problems. Sulphate imparts a bitter taste to the water and may act as laxative to new consumers unaccustomed to these sulphate

concentrations. Nitrate is often indicative of contamination from septic field, fertilizer, and manure pile sources. Excessive levels may cause methemoglobinemia or "blue baby" in infants (a condition where the red blood cells do not carry enough oxygen) whereby the child becomes lethargic and the skin takes on a blue hue.

There are four major types of treatment methods to remove these chemicals: reverse osmosis (Section 3.11), dealkalization (Section 3.12), deionization (Section 3.13), and distillation (Section 3.19).

2.6 Hydrogen Sulfide

Hydrogen sulfide gas is normally a byproduct of bacterial decay of organic matter. It is produced when microorganisms degrade sulfur-containing materials in environments free of oxygen. These microorganisms release hydrogen sulfide gas in a manner similar to release of carbon dioxide by humans. This problem is common in New Brunswick and is easily identified by a rotten egg odour. The problem can often be corrected by ensuring the well vent is clear and sufficient air contact with the water exists. Hydrogen sulfide can also be caused by the sacrificial anode within some hot water tanks.

Activated carbon or charcoal filters (Section 3.15) are effective for low levels of hydrogen sulfide (less than 1 milligram/litre). Hydrogen sulfide can also be removed by a chlorinator and filter (Section 3.6) or a greensand filter (Section 3.7).

2.7 Arsenic

Arsenic occurs naturally in many rocks, minerals, and soils. It has been noted in well water in southwestern New Brunswick. Arsenic is a cumulative toxin affecting the nervous system. The recommended limit for arsenic in drinking water in Canada is 0.05 milligrams/litre. It can be removed by means of a reverse osmosis unit (Section 3.11) and distillation units (Section 3.19).

2.8 Uranium

Uranium is widely distributed and is present in a variety of minerals. There are areas in Nova Scotia and southwestern New Brunswick where uranium occurs in trace concentrations in well water. In these areas, uranium is primarily found in water from drilled wells only. The recommended drinking water limit for uranium is presently 0.02 milligrams/litre. Uranium can be removed from drinking water by means of a distillation system (Section 3.19).

2.9 Hydrocarbons and Other Organic Chemicals

With increasing frequency, wells are becoming contaminated with such man-made chemicals as gasoline, fuel oil, perchloroethylene (PCE - a drycleaning solvent), phenols (from creosote) or trichloroethylene (TCE - a degreasing agent). When a well is contaminated with any man-made chemical, initial concern should focus on removing the source of the contamination. The treatment methods mentioned here should be regarded as temporary. Many of the methods are new and have not been fully tested.

Activated carbon filters have proven to be effective in removing hydrocarbons and other organic chemicals (Section 3.15). Reverse osmosis units are also apparently capable of removing the aforementioned chemicals (Section 3.11). There are also more exotic treatment methods available such as aeration units.

2.10 Sodium

Sodium concentrations are often the result of dissolution of salt - sodium chloride (i.e. common table salt). Of late, the sodium concentration in drinking water has become a concern for many people. Yet the intake of sodium from drinking water is only a small portion of that consumed in food. For instance, it is estimated that milk contains 520 milligrams/litre of sodium while tomato soup contains 3,900 milligrams/litre of sodium (United States Department of Agriculture).

The suggested drinking water limit for persons on salt-restricted diets is 20 milligrams/litre. Excessive amounts of sodium has been related to the development of high blood pressure and hypertension (National Academy of Sciences, 1977).

One source of sodium that seems to be of public concern is from water softeners which will add sodium to drinking water. The amount of sodium added is related to the hardness of the water (i.e. the harder the water, the more sodium added).

Sodium can be removed by means of reverse osmosis units (Section 3.11) and distillation units (Section 3.19).

3.0 TREATMENT UNITS AND METHODS

3.1 Chlorination

Chlorination is the most common method of disinfection. There are two types of chlorination: "shock" or "shot" chlorination, and continuous chlorination. Shot Chlorination involves the manual addition of a quantity of chlorine to a well (i.e. a bottle or two of Javex) to eliminate a temporary bacterial problem.

Continuous chlorination involves the addition of a small quantity of chlorine to the water system using a small chemical feed pump. It is used to disinfect a source of water, such as lake water, which at any time may contain disease-causing bacteria.

3.2 Iodination

In iodination, a controlled amount of iodine is added to the water by means of a chemical feed pump or an iodination cartridge. Use of iodine gives the water a residual ability to kill any bacteria in the plumbing system. Apparently, iodine does not give the water any objectionable taste or odour at proper treatment levels.

3.3 Ultraviolet Irradiation

Ultraviolet disinfection systems use the same killing action on bacteria as sunlight. The system consists of one or more ultraviolet lamps in a quartz sleeve. Water is directed past the lamp in a relatively thin layer so that all bacteria in the water are exposed. Unlike chlorination systems, the ultraviolet lamps

have no residual germicidal activity. Therefore, the plumbing system should be periodically cleaned and disinfected. The 40-90 watt lamp is run continuously and will last about a year.

3.4 Water Softeners

The units designed for the treatment of hardness are called water softeners. In the standard type of unit, water flows through an exchange resin charged with sodium. Calcium and magnesium in the water are traded for sodium. Once the resin becomes saturated with calcium and magnesium, it can be regenerated by backwashing with a brine solution which contains sodium. The sodium in the brine is now traded with the calcium and magnesium on the resin. The calcium and magnesium go to waste.

Water softeners increase the sodium content of the water. However, a tap for cold, unsoftened water may be installed for drinking purposes in the kitchen. Only the water to be heated and cold water used for laundry and washing purposes need be softened. Flush toilets use a large amount of water and a considerable saving can be realized by not softening this water.

Water softeners will also reduce the iron and manganese concentration of water. They are capable of removing up to 4.0 milligrams/litre of iron and 2.0 milligrams/litre of manganese. To use a softener effectively in removing iron and manganese, the water should be clear when drawn, have a pH no less than 7.0, and should be free of iron bacteria. A softener will remove iron and manganese when the pH is less than 7.0; however, the lower the pH, the less effective the method.

Iron and manganese in softeners can cause a problem if they oxidize and coat the resin bed. To prevent this, the softener can be set to regenerate more frequently at a lower salt dosage to decrease the chance of iron oxidation. Should the resin bed become iron-fouled, it can be cleaned with a resin cleaner such as "Iron-out," "Iron-free," and "Rover."

3.5 Phosphate Additives

An alternative method of hard water treatment is hardness-complexation with phosphate additives. Chemicals such as sodium hexametaphosphate are added to the water by a chemical feed pump. These chemicals prevent hard water from reacting with soap to form a scum. However, scale still forms in kettles and boilers.

3.6 Chlorine Oxidation

In chlorine oxidation, chlorine is added to cause iron and manganese to oxidize and form iron and manganese particles.

These particles are then removed with a filter. An additional benefit of this method is its ability to control iron bacteria.

3.7 Greensand Filters

The greensand unit contains sand or a resin coated with manganese dioxide. When water containing iron or manganese is passed through this material, the manganese dioxide on the sand causes the iron and manganese to come out of the water and coat the greensand. After the greensand is coated with iron and manganese, it is regenerated with potassium permanganate. The pH of the incoming water must be 7.0 or greater to prevent the dissolution of the manganese dioxide.

A modification of this process is available whereby potassium permanganate is continuously fed to the water before entering the filter. The iron and manganese are oxidized by the potassium permanganate so that they form particles which are trapped by the filter.

3.8 Tank-Type Neutralizing Filters

The tank-type neutralizing filter uses a mode of operation similar to chemical reactions which occur in nature. The filter-medium is crushed limestone, magnesium, or both. When acid water passes through the filter, it dissolves some of the limestone present in the filter. Thus, the water is somewhat hardened by the neutralization process.

The filters are not very effective on pH's lower than 6.0. A limestone filter, on average, will raise the pH of the water by approximately one pH unit.

3.9 Alkali Addition

A chemical feed pump using soda ash (sodium carbonate), calcium hydroxide or sodium hydroxide can neutralize water with a pH of 4.0 to 6.8 and involves a simple acid-base nuetralization. The alkali can often be injected directly into the well preventing any part of the plumbing system from contacting the corrosive water. Neutralization by this method requires the handling of dangerous caustic solutions.

3.10 Acid Addition

A chemical feed pump can be used to add sulfuric acid to neutralize scale-forming, extremely high pH waters.

3.11 Reverse Osmosis

Reverse osmosis involves passing mineralized water under pressure through a semi-permeable membrane. This membrane allows fresh water to pass through the membrane while leaving many of the minerals behind. Water is forced against the membrane in the unit. This part of the module retains the solids and, to prevent clogging, must be constantly washed and discharged to waste by the incoming water. It is estimated that for every

litre of water produced, four litres go to waste. An average, under-the-sink unit produces about 23 litres of treated water per day.

There are many types of reverse osmosis membranes. However, nylon and cellulose acetate are the most common. The membranes are highly susceptible to build-up of calcium or sulphate compounds on the membrane. Some species of bacteria may feed on the membrane requiring the use of chlorine or ozonation to kill the bacteria before they reach the membrane. Generally, iron and hardness should be removed by treatment with a softener or by some other method before the water reaches the membrane.

3.12 Dealkalization

A dealkalizer or anion exchange system is designed to remove sulfates. Working on the same principal as a water softener, the sulfates are exchanged for chlorides using a modified resin. The unit, therefore, increases the total chloride concentration. If chloride or salt is already a problem, this unit is not recommended.

3.13 Deionization

Deionization or demineralization is designed to remove all of the minerals from water. It operates like a water softener except there are two types of resins, one to remove positively-charged minerals (cations) and another to remove negatively-

charged minerals (anions). The use of ion exchange systems for demineralization should only be considered for treatment of water with less than 2000 milligrams/litre total dissolved solids.

3.14 Freezing/Thawing

Research has indicated that nitrates and other minerals can be separated from water by freezing the water. When 70 percent of the water is frozen, approximately 90 percent of the nitrate is concentrated in the remaining 30 percent of the liquid water. This water is then poured to waste and the ice is thawed for consumption. The result is water that contains 90 percent less nitrate than it did originally.

3.15 Activated Carbon or Charcoal Filters

Activated carbon filters can remove low concentrations of tastes and odours from a wide variety of sources. The activated carbon "absorbs" the offending chemicals on its surface.

There are two major types of activated carbon filters: cartridge-type and bed-type. Cartridge-type filters are easily installed directly on a faucet. Once they have used up their filtering capacity, the entire cartridge is replaced. There are also larger, under-the-sink cartridges available which can be backwashed to remove heavier solids buildup.

Bed-type carbon filters are designed to treat most of the water being used in a home. This type of unit is usually placed beyond the chlorinator and/or the water softener. The unit can

be backwashed periodically to remove suspended dirt. For an average household an activated carbon unit will last 1 to 3 years depending on the quality of the water processed and the intensity of taste and odour.

3.16 Coagulation

Coagulation is a process by which fine suspended particles collect into large particles that settle to the bottom. The process is started by adding a chemical to the water such as alum which causes suspended particles to combine and form larger particles which then settle. Factors affecting the coagulation rate include pH, water temperature, particle size, rate of water-coagulant mixing, and the quantity of coagulant used.

Other coagulants include ferric chloride and ferric sulfate. When the pH ranges between 6.8 and 7.5 alum is recommended. If the pH of the water is 5.5 to 8.8 ferric sulfate can be used.

3.17 Sedimentation

Sedimentation involves letting the water stand still while gravity causes the larger particles to settle out. It can be accomplished in a quiet pond, properly constructed tank or basin. For a significant reduction in suspended matter, the detention time must be at least 24 hours.

The inlet to the sedimentation tank should be designed so the incoming water is distributed across the entire width of the tank. The outlet should be located at the opposite end of the tank. Baffles can be used to reduce short circuiting of water and high local velocities. The system should be designed with two separate sections to facilitate cleaning and repair. The frequency of cleaning will depend on the tank size, turbidity, and water usage rate.

3.18 Sand Filters

Small quantities of sand and other particles can be removed with filters filled with sand or diatomaceous earth. These filters can be purchased as cartridges which can be added into the water line.

3.19 Distillation

Distillation units operate by boiling the water, gathering the resulting steam, and subsequently cooling/condensing it to liquid water. Bacteria are destroyed by the heat and minerals are left behind in the boiler. The process results in nearly pure water.

Distillation's main advantage is its simplicity of operation. No pretreatment is required. The units produce approximately 27 litres (i.e. six Imperial gallons) of drinking water per day. Essentially all of the minerals in the water are removed, making the unit suitable for treatment of practically any water quality

problem. The main disadvantages to distillation are both the power consumption involved and the noise which the unit can make.

3.20 Shot or Shock Chlorination

Chemical disinfection or shot chlorination is essential for new or repaired wells, cisterns, springs, pumps, and pipes. It is also used to correct iron bacteria problems. Disinfection is the final step after all defects in location and construction have been corrected and before samples are collected for bacterial examination. Disinfection using this method cannot be relied on for 100 percent destruction of harmful bacteria.

Shot chlorination is normally done with Javex or bleach although use of chloride of lime or calcium hypochlorite tablets is also common. To determine how much Javex or bleach to use:

1. Measure the depth of water in your well and calculate the volume of water present using Table 4 below:

TABLE 4

Water Volumes per Metre Based Upon Well Diameter

Well Diameter (centimetres)	Litres per Metre Depth	Well Diameter (centimetres)	Litres per Metre Depth
10	78.5	50	1,962.5
15	176.6	60	2,826.0
20	314.0	70	3,846.5
25	390.6	75	4,415.6
30	706.5	90	6,358.5
35	961.6	120	11,304.0
40	1,256.0	150	17,662.5
45	1,589.6		

2. Add one litre of liquid laundry bleach (i.e. Javex) for every 275 litres of water in the well.

After determining how much bleach to add, carefully pour half of that amount into the well. Remember, the bleach is quite corrosive. Proper handling is required to protect against skin contact. The solution may also be poured or siphoned through the air vent pipe. Then start the pump and open all taps until water from each tap has a distinct odour. Stop the pump and add the remainder of the bleach to the well. Allow to stand 12 to 24 hours and then repeat until the chlorine odour disappears from the water. A sample should then be taken for bacterial analysis. If possible, additional check samples should be collected after two weeks.

APPENDIX 1

PUBLIC HEALTH INSPECTORS OFFICES IN NEW BRUNSWICK:

Moncton : P.O. Box 5001, 770 Main Street, E1C 8R3.
Tel: 858-2575 or 858-2573

Saint John : P.O. Box 93, 157 Duke Street, E21 3X1.
Tel: 658-2455

Sussex : P.O. Box 5001, Sussex Health Centre, E0E 1P0.
Tel: 433-4205

St. Stephen : P.O. Box 5001, 268 Water Street, E0G 3A0.
Tel: 466-1402

Fredericton : P.O. Box 5001, 300 St. Marys Street, E3B 5H1.
Tel: 453-830, 453-2823, or 453-2824

Woodstock : P.O. Box 5001, Bicentennial Building, E0J 2B0.
Tel: 328-9966

Perth-Andover: P.O. Box 214, E0J 1V0.
Tel: 273-2229

Edmundston : P.O. Box 5001, 121 Church Street, E3B 1J4.
Tel: 739-9588

Grand Falls : P.O. Box 5001, 141 Court Street, E0J 1M0.
Tel: 473-3774

Campbellton : P.O. Box 5001, 157 Water Street, E3N 3H5.
Tel: 753-7738

Tracadie : P.O. Box 388, Provincial Building, E0C 2B0.
Tel: 395-3391

Bathurst : P.O. Box 5001, 350 St. George Street, E2A 1B9.
Tel: 548-3313

Chatham : P.O. Box 5001, 53 Lobban Avenue, E1N 3A8.
Tel: 773-5863

ENVIRONMENTAL INSPECTORS OFFICES IN NEW BRUNSWICK:

Moncton : P.O. Box 5001, 774 Main Street, E1C 8R3.
Tel: 858-2588

Chatham : Provincial Building, 337 Water Street, E1N 1B2.
Tel: 773-6032

Bathurst : P.O. Box 5001, E2A 3Z9.
Tel: 546-2360

Grand Falls: P.O. Box 5001, E0J 1M0.
Tel: 473-5268

Saint John : 12th Floor, Suite 1232, City Hall.
Tel: 658-2258

Fredericton: 2nd Floor, 364 Argyle Street, E3B 5H1.
Tel: 453-2861